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Feeding Farm Horses and Mules.

N. C. COLLEGE OF AGRICULTURE AND MECHANIC ARTS.

THE NORTH CAROLINA

AGRICULTURAL EXPERIMENT STATION

UNDER THE CONTROL OF THE

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THE AGRICULTURAL EXPERIMENT STATION,
RALEIGH, N. C

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FEEDING FARM HORSES AND MULES

BY CHARLES Wm. BURKETT

North Carolina imports a good deal of feeding stuffs for her horses and mules. Various kinds of hay and grain materials are annually brought into the State to supply the demand for feeds for working animals. Is this necessary? Must the farmer go out of the State and buy materials for his work horses and mules? Is it true that he can not raise the necessary grain and hay on his farm for feeding his working stock? Since it is true that we do not produce what our horse and mule stock consume, then any discussion that is concerned with the production and feeding of home-grown feeding stuffs is worthy of the most careful and thoughtful consideration.

Since many of our farmers grow cotton and tobacco and trucking crops, they often neglect the growing of hay and grain for live stock. Some say they do this because they can not grow timothy hay and oats, therefore if they are to feed properly their horses and mules they must buy these feeding stuffs.

The whole question hinges on feeding the proverbial horse ration—timothy hay, corn and oats. The real question should be, in case this proverbial ration can not be grown, is there any substitute for it? Are there other feeding stuffs that can be produced that will serve as satisfactorily so as to keep the working stock in good form? This bulletin is concerned in answering this question. A number of feeding stuffs have been used, the greater part of which are home-grown in every section of the State.

Some of them are soil-improvers in their growing; some are heavy yielders in many sections; some are admirably adapted as a part of a system of crop rotation; some are winter crops; some are grown with ease and little labor. They answer the question in a practical manner.

Crops Grown in the State.

Corn for grain, ensilage and stover, and the cowpea for grain and hay can be and now are grown in every part of the State; crimson clover is a reasonably sure crop over much of the State; common red clover is more or less grown, and its acreage can be widely extended; cotton seed meal and bran, excellent and cheap, for the nutrients they contain are available everywhere. These are a few feeding stuffs that can be used for horses and mules, and all can

be produced practically everywhere in the State. They make a practical basis for good, efficient working rations.

The Experiments.

The feeding experiments were conducted through a period of parts of two years, beginning March, 1902, and ending October, 1903. The college horses and mules were used in the experiments during the period. Their weights were taken weekly, and the number of hours work recorded. A number of rations have been compared, consisting of both grain and roughage materials.

The experiments were planned to compare a number of feeding stuffs to determine what ones were most effective in performing the work and in keeping the animals in condition; and at the same time to use such feeds as are readily obtained in the State and from the farm. With but two or three exceptions the materials were grown on the college farm and likewise are available to every farm in the State. The exceptions just mentioned refer to dried blood, tankage and gluten meal.

The comparisons are made in all cases by using animals that were paired in a working team. Thus in all cases the conditions relating to the kind and amount of work are the same; that is, two horses were used as a team, plowing, for instance, with a two-horse plow. They worked side by side, they were driven and handled by the same teamster, and under the same conditions of shelter, water and grooming, and one was fed one ration and the other a different ration. We think, therefore, the comparisons are legitimate, accurate and safe. In discussing the experiments two terms are often used—the period average, and the experimental normal or normal weight.

The latter was obtained by taking the average weight for each animal during the whole experimental period included in the two years. The period average refers to the average weight obtained by taking the average of the special period under discussion.

Cost of Feeding Stuffs.

The feeding stuffs used in the experiments have been rated as follows: Corn $20; bran $20; corn and cob meal $17; wheat 90 cents; oats 50 cents; cowpeas 60 cents; cotton seed meal $24; gluten meal $22; corn ensilage $2; cowpea hay $10; oat hay $10; clover hay $10; corn stover $5; and meadow hay $10.

Comparing Bran and Cowpea Hay.

The first comparison extended through a period of twelve weeks, beginning March 6 and ending May 29, 1902.

The rations are as follows:

RATION I—BRAN RATION.

10 pounds bran.
12 pounds corn and cob meal.
2½ pounds gluten meal.
15 pounds corn stover.
Cost 28.9 cents daily.

RATION II—COWPEA HAY RATION.

10 pounds cowpea hay.
12 pounds corn and cob meal.
2½ pounds gluten meal.
15 pounds corn stover.
Cost 23.9 cents daily.

It will be noticed the only difference between these rations is the substitution of cowpea hay for bran, the other feeding stuffs remaining the same in both. The result of three months feeding is seen in the table following, where the weights of each horse are given.

This trial covers a period of the year that is ordinarily the hardest because of the strenuous effort necessary for spring planting.

TABLE I—*Comparing Bran and Cowpea Hay.*

	RATION I.		RATION II.
Horse.	Daisy.	Date.	Doll.
Weights	1200	March 6	1285
	1156	13	1288
	1170	20	1239
	1175	27	1258
	1131	April 3	1231
	1161	10	1241
	1145	17	1186
	1143	24	1209
	1065	May 1	1253
	1121	8	1225
	1149	15	1271
	1152	22	1277
	1153	29	1302
Period average	1148		1251
Normal	1210		1308
Work done	731		731

It will be seen by the table that Daisy on the bran ration after the first weighing held her own throughout the period. It is true she lost in weight the first week, but after that her weights were more or less stable. This shows the ration was satisfactory in every way. The average weight for the period was 1,148, or slightly under the normal weight. It should be mentioned here that all the animals at the beginning of these experiments were below the experimental normal; all were in better condition and flesh at the end than at the beginning.

The table also shows that where ten pounds of cowpea hay were given to Doll, they proved as valuable for feeding as an equal quan-

tity of bran. In fact, by glancing at the several weighings it will be seen that Doll really weighed at the end of the period more than at the beginning, which shows beyond a doubt that the ration was satisfactory. The cowpea ration was also five cents less in daily cost. This is a matter of considerable importance, and, as a fact, is much in the favor of this feeding stuff for farm horses.

Both of these rations were thoroughly satisfactory, and both are almost wholly home-grown.

Rations Three and Four.

Ration III.	Ration IV.
10 pounds corn and cob meal.	5 pounds corn and cob meal.
15 pounds cowpea hay.	2 pounds gluten meal.
	1 pound cotton seed meal.
	5 pounds cowpea hay.
	12 pounds corn stover.
Daily cost 16.0 cents.	Daily cost 13.1 cents.

These two rations were fed Tom and George, two small-sized mules, from March 6 to May 8. The tables below show the results:

	Ration III.		Ration IV.
Horse.	Tom.	Date.	George.
Weights	767	March 6	777
	746	13	769
	747	20	756
	744	27	765
	762	April 3	727
Average	753		759
Normal	753		779
Work done	179.5		179

On April 3 the rations were reversed and continued till May 8. The results are as follows:

	Ration III.		Ration IV.
Horse.	George.	Date.	Tom.
Weights	727	April 3	762
	750	10	766
	706	17	756
	726	24	744
	740	May 1	696
	745	8	716
Average	732		740
Normal	779		753
Work done	278		255

When fed on ration III, composed of cowpea hay and corn and cob meal, Tom practically held his own, while George gained in weight. On ration IV both lost in weight. The difference is slight, however, and the addition of a couple of pounds of corn and cob meal would likely make stable results and a very satisfactory ration, and still be moderate in cost.

Rations Five and Six.

Roxy and Rhody, two young mules just broken to work, were fed from March 6, 1902, to May 8, the following rations, with weights and results herewith:

Ration V.

4 pounds gluten meal.
4 pounds corn stover.
10 pounds corn and cob meal.
8 pounds cowpea hay.
Daily cost 17.9 cents.

Ration VI.

8 pounds oats.
10 pounds corn and cob meal.
8 pounds cowpea hay.

Daily cost 24.9 cents.

Horse.	Rhody.	Date.	Roxy.
Weights	973	March 6	935
	985	13	940
	975	20	939
	970	27	953
	940	April 3	922
Average	969		939
Normal	1012		966
Work done	195		195

Horse.	Roxy.	Date.	Rhody.
Weights	922	April 3	940
	936	10	956
	918	17	971
	900	24	934
	905	May 1	933
	930	8	936
Average	918		945
Normal	966		1012
Work done	315		280

It will be seen in studying these two tables that while Rhody in ration V lost somewhat in weight, the period average is but four pounds below the weight at the beginning. Roxy, on the other hand, has an average gain of four pounds over the weight at beginning.

When the rations were reversed we find there is a loss in weight, as shown by the averages for both mules. Rhody, on the oat ration, lost 24 pounds on the average, and Roxy on the gluten—corn stover ration—lost 21 pounds. The difference in rations, therefore, is not marked except in cost, which is seven cents in favor of the gluten—corn stover ration. The gluten was not relished by either of these mules; they did not like it, nor would they acquire a taste for it. The difference of cost is worthy of consideration. Where animals can be gotten to eat gluten we think it a splendid feeding stuff. All the other animals used in these experiments readily ate the gluten meal.

On May 8th both rations were changed, the quantity of oats was decreased in the one ration, and bran was substituted for the gluten meal in the other. Clover hay was used as roughage. The following shows the rations and the results:

RATION 7.

10 pounds clover hay.
10 pounds corn and cob meal.
1 pound cotton seed meal.
5 pounds oats.
Daily cost 22.5 cents.

RATION 8.

10 pounds clover hay.
10 pounds corn and cob meal.
1 pound cotton seed meal.
5 pounds bran.
Daily cost 19.7 cents.

Horse.	Roxy.	Date.	Rhody.
	930	May 8	936
	936	15	982
	947	22	976
	942	29	983
Weights	894	June 5	919
	910	12	925
	938	19	921
	936	26	970
	933	July 3	960
Average	929		952
Normal	966		1012
Work done	488		514

Here we see a slight increase in weight with both animals, when the averages are considered in connection with the preceding table. When the weights at beginning and end are considered, we see Roxy gained three pounds and Rhody 24 pounds. All in all, we think the conclusion is warranted that the bran took the place of oats, and at a saving of nearly three cents daily. On July 3 the rations were changed by using oat hay in place of clover hay. The rations, otherwise, remained the same. The results are seen in the table following:

RATION 9.

5 pounds bran.
10 pounds corn and cob meal.
1 pound cotton seed meal.
10 pounds oat hay.
Daily cost 19.7 cents.

RATION 10.

5 pounds oats.
10 pounds corn and cob meal.
1 pound cotton seed meal.
10 pounds oat hay.
Daily cost 22.5 cents.

Horse.	Rhody.	Date.	Roxy.
Weights	960	July 3	933
	950	10	931
	976	17	933
	986	24	967
	1023	31	954
	983	August 7	941
Average	980		943
Normal	1012		966
Work done	181		131

The table shows that both mules increased in weight. Rhody's average has gone from 952 to 980; Roxy's from 929 to 943, the increase being a little greater with Rhody on the bran ration. The difference here is favorable to bran over oats both in respect to cost and increase in weight.

RATIONS ELEVEN AND TWELVE.

Rations similar to those fed to Rhody and Roxy as discussed in the preceding tables, were fed Daisy and Doll immediately on the completion of the experiment where bran was compared with cow-pea hay. The table following shows the results:

RATION 11.

4 pounds bran.
2 pounds cotton seed meal.
10 pounds corn and cob meal.
15 pounds clover.
Daily cost 22.4 cents.

RATION 12.

4 pounds oats.
2 pounds cotton seed meal.
10 pounds corn and cob meal.
15 pounds clover hay.
Daily cost 24.6 cents.

Horse.	Daisy.	Date.	Doll.
Weights	1153	May 29	1302
	1109	June 5	1259
	1196	12	1275
	1172	19	1280
	1186	26	1303
	1184	July 3	1306
Average	1167		1287
Normal	1210		1308
Work done	300		299

It is seen here that while the period average is still below the normal average, there is a gain for Daisy where bran formed a part of the ration. The period average at this time was 1,167, as against 1,148 in the preceding experiment. Doll likewise gained in weight; the period average advanced from 1,251 to 1,287.

It is also noticed when the weighings at the beginning and ending are considered, that Daisy on the bran ration gained 31 pounds, and Doll on the oat ration 4 pounds. From this we can conclude that both rations are satisfactory, though the bran ration is some two cents the cheapest. On July 3 oat hay was substituted for the clover hay. The cost of both rations is the same, since oat hay is here rated at the same price per ton. The table below shows the results:

Ration 13.	Ration 14.
4 pounds bran.	4 pounds oats.
2 pounds cotton seed meal.	2 pounds cotton seed meal.
10 pounds corn and cob meal.	10 pounds corn and cob meal.
15 pounds oat hay.	15 pounds oat hay.
Daily cost 22.4 cents.	Daily cost 24.6 cents.

Horse.	Daisy.	Date.	Doll.
Weights	1184	July 3	1306
	1186	10	1291
	1208	17	1297
	1238	24	1348
	1243	31	1342
	1247	August 7	1331
Average	1218		1319
Normal	1210		1308
Work done			

We note at once an increase with both horses. Here the period average is above the experimental normal in both cases. Surely both rations are satisfactory, or the increase would not be so marked.

In this double period experiment both horses ate readily the cotton seed meal in the rations. The results for the two periods show that bran is a satisfactory substitute for oats. A ton of oats contains 1,014 pounds of digestible nutrients, which cost in these experiments $31.25. A ton of bran contains 1,082 pounds of digestible nutrients, which cost but $20, a saving difference of $11.25 on each ton used. When this fact is considered, we see the force and value of the substitution.

Corn and Cob Meal Versus Shelled Corn.

The feeding of corn and cob meal in comparison with shelled corn, when clover hay was used as a roughage, was tested with Tom and

George from May 8 to July 3, with results as shown in following table:

Ration 15.	Ration 16.
10 pounds corn and cob meal.	10 pounds shelled corn.
10 pounds clover hay.	10 pounds clover hay.
Daily cost 13.5 cents.	Daily cost 15 cents.

Horse.	Tom.	Date.	George.
Weights	716	May 8	745
	734	15	743
	740	22	786
	730	29	788
	731	June 5	723
	692	12	783
	712	19	778
	726	26	781
	738	July 3	780
Average	724		767
Normal	753		779
Work done	402		464

Here the average is below the experiment normal in both, still both weighed more at the end of the test than at the beginning. We are justified in saying that both rations are satisfactory, and also that the corn and cob meal was practically equivalent to an equal quantity of shelled corn. This test was continued from July 3 to August 7, with oat hay as the roughage, and an increase of one pound in quantity of grain for both. The table below shows the results:

Ration 17.	Ration 18.
11 pounds corn and cob meal.	11 pounds shelled corn.
10 pounds oat hay.	10 pounds oat hay.
Daily cost 14.3 cents.	Daily cost 16 cents.

Horse.	Tom.	Date.	George.
Weights	738	July 3	780
	711	10	780
	743	17	789
	745	24	776
	768	31	818
	751	August 7	808
Average	743		792
Normal	753		779
Work done	122		144

Both mules have gained in weight. George's average is above the normal, and Tom's not far below. George also did a little more work. The table shows results slightly in favor of the shelled corn. On August 7 both mules were given clover hay again, with grain the same. Following are the results:

Ration 15.	Ration 16.
11 pounds corn and cob meal.	11 pounds shelled corn.
10 pounds clover hay.	10 pounds clover hay.
Daily cost 14.3 cents.	Daily cost 16 cents.

Horse.	Tom.	Date.	George.
Weights	751	August 7	808
	752	14	791
	745	21	793
	774	28	792
	770	September 4	802
	773	11	808
	787	18	797
Average	765		799
Normal	753		779
Work done	118		241

It will be noticed by comparing the last two tables that Tom's average has advanced 22 pounds and George's 7 pounds. Both are now above the normal and both rations are satisfactory. The three trials point to the conclusion that corn and cob meal is a reasonably fair substitute for shelled corn.

Corn Ensilage.

A number of experiments have been conducted at several of our Stations to examine into the value of corn ensilage for beef and dairy cattle, but little is known of its value or use in horse-feeding.

To test the value of this feeding stuff in horse-feeding, Daisy and Doll were fed for five weeks beginning August 7, 1902. Since both were worked together, and at the same kind of work and under the same conditions, the results here obtained are particularly useful in throwing light on this important subject. The results are seen in the next table. It will be noticed there is a difference of 4½ cents in daily cost to the advantage of the ensilage ration, which is worthy of considerable consideration, especially where several horses are kept, where the usual roughage is not easily obtained, but where corn is grown easily and successfully.

RATION 19.

30 pounds corn ensilage.
10 pounds corn and cob meal.
1 pound tankage.
1 pound cotton seed meal.
4 pounds bran.
Daily cost 18.2 cents.

15 pounds oat hay.
10 pounds corn and cob meal.
1 pound tankage.
1 pound cotton seed meal.
4 pounds bran.
Daily cost 22.7 cents.

Horse.	Daisy.	Date.	Doll.
Weights	1247	August 7	1331
	1201	14	1319
	1202	21	1307
	1234	28	1316
	1244	September 4	1374
	1258	11	1339
Average	1231		1331
Normal	1210		1308
Work done	192		188

Both horses are above the normal in weight. Daisy gained slightly, and Doll easily held her own. Surely the results show conclusively that both rations are satisfactory.

On September 11 it was thought best to continue the test and to use clover hay in place of oat hay, and also to reverse horses and rations. An extra pound of tankage was also used in place of the cotton seed meal. The results are seen below:

RATION 21.

30 pounds corn ensilage.
10 pounds corn and cob meal.
2 pounds tankage.
4 pounds bran.
Daily cost 18.5 cents.

RATION 22.

15 pounds clover hay.
10 pounds corn and cob meal.
2 pounds tankage.
4 pounds bran.
Daily cost 23 cents.

Horse.	Doll.	Date.	Daisy.
Weights	1339	September 11	1258
	1343	18	1204
	1300	25	1265
	1340	October 2	1182
Average	1330		1227
Normal	1308		1210
Work done	98½		93½

Doll has held her own as seen by the period average; Daisy has lost slightly. Both rations are seen by these tests to be satisfactory, and corn ensilage must be considered a worthy feeding stuff for

horse. It was now thought advisable to compare corn and corn ensilage with corn and cowpea hay, the efficiency of the latter ration already having been demonstrated. Following are the results:

RATION 23.

15 pounds cowpea hay.
21 pounds corn on ear.
Daily cost 25.4 cents.

RATION 24.

30 pounds corn ensilage.
21 pounds corn on ear.
Daily cost 20.8 cents.

Horse.	Daisy.	Date.	Doll.
Weights	1182	October 2	1340
	1182	9	1305
	1280	16	1270
	1298	23	1290
Average	1235		1301
Normal	1210		1308
Work done	173		179

We seen that Daisy continues to increase in weight, since the ration is sufficient and furnishes the necessary nutrients. Doll loses steadily in weight, bringing the period average down again, and below the normal. We expected this, since both feeds are low in protein, the ration furnishing too little of this constituent. To correct the loss in weight, two pounds each of bran and cotton seed meal were added to the ration and the same fed to both horses. The results are seen in the next table:

RATION 25.

30 pounds corn ensilage.
21 pounds corn and cob meal.
2 pounds cotton seed meal.
2 pounds bran.
Daily cost 25.2 cents.

Horse.	Daisy.	Date.	Doll.
Weights	1298	October 23	1290
	1290	30	1380
	1300	November 6	1350
Average	1296		1340
Normal	1210		1308
Work done	114		114

The results show that the addition of the grain of a protein nature to the unbalanced one causes Doll to recover her loss quickly. Daisy also has gained in weight.

On November 6 both horses were given the following feeding stuffs, termed here as—

RATION 26.

21 pounds of corn and cob meal.
12 pounds cowpea hay.
9 pounds corn stover.
Daily cost 26.1 cents.

Horse.	Daisy.	Date.	Doll.
Weights	1300	November 6	1350
	1240	13	1302
	1230	20	1297
	1250	27	1330
	1300	December 7	1340
	1250	11	1340
	1270	18	1330
Average	1263		1327
Normal	1210		1308
Work done	306		306

This ration costs more than the preceding, and is not so satisfactory. However, after the first week both horses held their own and gained slightly. The ration is wholly home-grown and satisfactory for winter feeding where work is not constant and hard.

CORN ENSILAGE FOR MULES.

Beginning August 7 these two mules were used for testing the feeding value of corn ensilage. The rations used for the comparison, and the results, are seen in next table:

RATION 27.

25 pounds corn ensilage.
10 pounds corn and cob meal.
1 pound dried blood.
4 pounds bran.
Daily cost 16.5 cents.

RATION 28.

10 pounds clover hay.
10 pounds corn and cob meal.
1 pound dried blood.
4 pounds bran.
Daily cost 19 cents.

Horse.	Rhody.	Date.	Roxy.
Weights	983	August 7	941
	991	14	950
	993	21	985
	986	28	966
	1000	September 4	980
	958	11	980
Average	985		967
Normal	1012		966
Work done	254		203

Both rations are seen to be satisfactory, and both are moderate in cost.

The rations were then changed and are as follows, with weights for the period:

Ration 29.	Ration 30.
25 pounds corn ensilage.	10 pounds cowpea hay.
16 pounds corn and cob meal.	16 pounds corn and cob meal.
Daily cost 16.1 cents.	Daily cost 18.6 cents.

Horse.	Roxy.	Date.	Rhody.
	980	September .. 11	958
	986	18	1015
Weights	1016	25	1021
	987	October 2	994
	960	9	970
	980	16	998
Average	985		993
Normal	966		1012
Work done	320		294

In this case Roxy held her own on the ensilage ration. Rhody, under same conditions, made decided gain. These two tests show that both mules did well where ensilage formed a part of the ration.

On September 18 Tom and George were each fed ten pounds of corn and cob meal, and for roughage Tom was given corn ensilage and George clover hay. The weighings and other data are given in the next table:

Ration 31.	Ration 32.
25 pounds corn ensilage.	10 pounds clover hay.
10 pounds corn and cob meal.	10 pounds corn and cob meal.
Daily cost 11 cents.	Daily cost 13.5 cents.

Horse	Tom.	Date.	George.
	787	September .. 18	797
	766	25	799
Weights	779	October 2	801
	720	9	767
	765	16	796
	794	23	810
Average	768		795
Normal	753		779
Work done	160		311

Both mules have held their own, as seen by the table. The period averages are above the normal averages. Tom has gained three pounds on his average over the previous one, and George has lost four. This is slight indeed, and may be due to difference in amount of work done.

Mary and Sue, two young mules, were purchased the first of August and were used for the test which follows:

Ration 33.	Ration 34.
30 pounds corn ensilage.	10 pounds clover hay.
15 pounds ear corn.	15 pounds ear corn.
Daily cost 15.7 cents.	Daily cost 17.7 cents.

Horse.	Mary.	Date.	Sue.
Weights	1090	August 7	983
	1031	13	954
	1086	21	951
	1083	27	982
	1087	September 4	997
	1101	11	971
Average	1079		973
Normal	1091		984
Work done	240		252

The rations were reversed on September 11 and continued until October 23. The results are seen in the following table:

Ration 33.	Ration 34.
30 pounds corn ensilage.	10 pounds clover hay.
15 pounds ear corn.	15 pounds ear corn.
Daily cost 15.7 cents.	Daily cost 17.7 cents.

Horse.	Sue.	Date.	Mary.
Weights	971	September 11	1101
	987	18	1121
	985	25	1087
	978	October 2	1110
	965	9	1090
	980	16	1095
	1010	23	1112
Average	986		1102
Normal	984		1091
Work done	256		247

In the preceding table it will be noticed that Mary, on ensilage, gained slightly in the end, although her average is somewhat below

the weight at the beginning, when she was unused to work. Sue at this time slightly lost in weight; when, however, she was put on the ensilage ration she gained and changed the period average from 973 to 986. Mary, on the clover hay ration, also gained. From these results and those obtained from feeding Daisy and Doll similar rations, we thought it likely that not enough protein was being furnished in the ensilage ration, so the quantity of ensilage was decreased and two pounds of bran and one pound of cotton seed meal were added. The bran and meal were sprinkled on the ensilage. Here are the results in the following table:

RATION 35.

21 pounds corn ensilage.
15 pounds ear corn.
2 pounds bran.
1 pound cotton seed meal.
Daily cost 18 cents.

Horse.	Mary.	Date.	Sue.
Weights	1112	October 23	1010
	1130	30	1015
	1110	November 6	999
Average	1117		1008
Normal	1090		984
Work done	119		119

Both mules increase in weight and raise the period averages. The ration is a good one in every way.

All things considered, the addition of corn ensilage to a ration improves it. Where it was tried with two horses and six mules, the results were satisfactory in the fullest sense as seen by the preceding tables. The animals were sleek, active, and always in good condition. When we consider the fact that a silo costs but little, and that corn can be produced in every section of the State, from the coast to the mountains, we find at once a partial solution to the problem of feeding farm horses and mules. Corn ensilage and the silo should receive more attention than they have in North Carolina.

COWPEA HAY AND CORN STOVER.

These feeding stuffs have been frequently used in tests heretofore discussed. The attempt has not been made to compare them, one against the other, but to study their value where rational rations are compounded of which they are a part.

On October 16 Roxy and Rhody were fed the same ration, made as follows, with results seen herewith:

RATION 36.

15 pounds corn and cob meal.
1½ pounds cotton seed meal.
10 pounds cowpea hay.
Daily cost 19.5 cents.

Horse.	Rhody.	Date.	Roxy.
Weights	998	October 16	980
	1020	23	996
	1028	30	1004
	995	November 6	1005
	991	13	980
	979	20	955
	1010	27	1000
	1040	December 4	1000
	1020	11	1005
	1015	18	1010
Average	1010		993
Normal	1012		966
Work done	500		500

This home-grown ration, as seen by the table, is thoroughly satisfactory.

Tom and George were fed corn stover as a roughage from October 16 to December 11. The results are seen in the next table:

RATION 37.

10 pounds corn and cob meal.
1 pound cotton seed meal.
10 pounds corn stover.
Daily cost 12.2 cents.

Horse.	Tom.	Date.	George.
Weights	794	October 23	810
	795	30	830
	806	November 6	810
	790	13	801
	770	20	803
	720	27	780
	700	December 4	775
	770	11	790
Average	772		799
Normal	753		779
Work done	203		400

This is an inexpensive ration and satisfactory for winter feeding. It is available to every farmer. The stover thus used takes the place of expensive hay and at no cost to the farmer. Instead of perishing in the fields, as it now does, it could readily find a place in the winter feeding of farm horses and mules.

Comparing Shelled Corn and Corn-Cob Meal.

On January 1, 1903, Daisy and Doll were weighed and fed the following rations, to determine the value, if any, in grinding corn and cob. The results are seen in the following table:

Ration 38.	Ration 39.
21 pounds shelled corn.	21 pounds corn and cob meal.
12 pounds cowpea hay.	12 pounds cowpea hay.
Daily cost 27 cents.	Daily cost 23.8 cents.

Horse.	Daisy.	Date.	Doll.
Weights	1280	January 1	1220
	1270	15	1385
	1250	22	1330
	1260	30	1332
	1260	February 5	1360
	1262	12	1365
	1240	19	1330
	1215	26	1325
	1200	March 5	1310
Average	1248		1329
Normal	1210		1308
Work done	381		335

This table shows conclusively in this trial that corn and cob meal was just as valuable as an equal quantity of shelled corn.

At the same time Rhody and Roxy were put on similar rations, though with smaller quantity of grain. Following are the results:

Ration 40.	Ration 41.
16½ pounds shelled corn.	16½ pounds corn and cob meal.
12 pounds cowpea hay.	12 pounds cowpea hay.
Daily cost 22.5 cents.	Daily cost 20 cents.

Horse.	Rhody.	Date.	Roxy.
Weights	960	January 1	950
	1020	15	1020
	1010	22	1000
	1040	30	1009
	1045	February 5	1040
	1040	12	1122
	1038	19	1015
	1041	26	1011
	1000	March 5	1016
	1019	12	1019
Average	1021		1020
Normal	1012		966
Work done	473		440

Here is a period gain over the last period of 11 pounds for Rhody and 27 pounds for Roxy. The corn and cob meal in this case is as good as an equal quantity of shelled corn. The corn and cob meal is 2½ cents cheaper. Still, both are satisfactory.

On March 12 it was thought advisable to substitute 4 pounds of bran for 6½ pounds of corn, and to use corn stover in place of the cowpea hay. It should be noted that these rations are therefore smaller than the foregoing.

Ration 42.	Ration 43.
10 pounds ear corn.	10 pounds corn and cob meal.
4 pounds bran.	4 pounds bran.
12 pounds corn stover.	12 pounds corn stover.
Daily cost 15.5 cents.	Daily cost 15.5 cents.

Horse.	Rhody.	Date.	Roxy.
Weights	1019	March 12	1020
	990	19	1004
	1035	26	1000
	988	April 2	1010
	985	9	985
	992	16	1012
	990	22	1010
	930	30	970
	1000	May 7	1002
Average	993		1001
Normal	1012		966
Work done	411		426

In this trial the quantity of each feeding stuff was precisely the same. The quantity of corn includes the weight of the cob in both cases. In the one, Rhody left the cob in the manger; Roxy ate the cob, since it was ground. Both mules slightly lost in weight. By comparing the weights at beginning and ending, Rhody, on ear corn, lost 19 pounds and Roxy, on corn and cob meal, lost 9 pounds. By comparing the period averages for this and the preceding period we notice that the loss for Rhody is 28 pounds and for Roxy 19 pounds. The difference here is in favor of the ground corn.

On May 7 clover hay was given in place of stover. The data is shown herewith:

RATION 44.

10½ pounds corn on ear.
4 pounds bran.
16 pounds clover hay.
Daily cost 20.9 cents.

RATION 45.

10½ pounds corn and cob meal.
4 pounds bran.
16 pounds clover hay.
Daily cost 20.9 cents.

Horse.	Rhody.	Date.	Roxy.
Weights	1000	May 7	1002
	1008	14	1006
	994	21	1010
	996	28	995
Average	999		1003
Normal	1012		966
Work done	207		208

Both have slightly gained in weight, the difference, if any, being too small to notice.

Similar experiments were made with Mary and Sue to test the value, if any, of grinding corn. Following are the rations and results:

RATION 46.

16½ pounds shelled corn.
12 pounds cowpea hay.
Daily cost 22.5 cents.

RATION 47.

16½ pounds corn and cob meal.
12 pounds cowpea hay.
Daily cost 20 cents.

Horse.	Mary.	Date.	Sue.
Weights	1005	January 1	926
	1040	15	985
	1100	22	990
	1120	30	980
	1130	February 5	1000
	1132	12	985
	1128	19	990
	1122	26	1000
	1122	March 5	1020
	1120	12	987
Average	1102		973
Normal	1091		984
Work done	449		439

On these rations both mules make decided gains. The corn and cob meal here seems to be as satisfactory as an equal amount of shelled corn. At this point in these comparisons the rations were changed and used here as follows:

RATION 48.
10½ pounds ear corn.
6 pounds bran.
12 pounds corn stover.
Daily cost 17.9 cents.

RATION 49.
10½ pounds corn and cob meal.
6 pounds bran.
12 pounds corn stover.
Daily cost 17.9 cents.

Horse.	Mary.	Date.		Sue.
	1120	March	12	987
	1080		19	970
	1120		26	980
	1115	April	2	975
	1100		9	970
Weights	1126		16	972
	1120		23	975
	1170		30	966
	1170	May	7	980
	1118		14	988
	1130		21	1000
	1125		28	995
	1120			
Average	1103			981
Normal	1091			984
Work done	521			516

The difference is small indeed. Mary weighs just the same at the end as she did at the beginning. Sue has gained 8 pounds.

These tests, taken all together, show a slight gain for the ground corn and cob. In some of the tests the differences were marked; in others, if any at all, they were small. While these tests tend to show the value of grinding corn and cob for feeding horses and mules, they need to be substantiated by further feeding trials. Whether one is justified in grinding or not the writer is not able to say. If a grinding mill is on the premises we think it will pay, but if one is obliged to haul corn any distance to a mill, it is doubtful.

CORN, WHEAT, COWPEAS AND OATS.

These four grain feeds are usually available for feeding horses and mules in North Carolina. The experiments following were conducted in the interest of comparisons and to determine their relative values when fed to working animals.

WHEAT COMPARED WITH COWPEAS.

Ration 50.	Ration 51.
8 pounds corn and cob meal.	8 pounds corn and cob meal.
4 pounds ground wheat.	4 pounds ground cowpeas.
12 pounds meadow hay.	12 pounds meadow hay.
Daily cost 18.8 cents.	Daily cost 16.8 cents.

Horse.	Rhody.	Tom *	Date.	Roxy.	George.*
Weights	978	729	August 7	974	756
	1010	750	14	1016	792
	990	752	21	996	788
Average	993	744		995	779
Normal	1012	753		966	779
Work done	83	60		83	85

*Tom and George were fed ¾ quantity of ration mentioned.

The table shows a gain for all the mules, hence both rations are satisfactory. The total gain for Rhody and Tom is 35 pounds, and for Roxy and George 54 pounds, a slight difference in favor of the cowpeas.

On August 21 oat hay was given in place of meadow hay, and the quantity increased to 14 pounds daily. The data are shown herewith:

Ration 52.	Ration 53.
4 pounds ground wheat.	4 pounds cowpeas, ground.
8 pounds corn and cob meal.	8 pounds corn and cob meal.
14 pounds oat hay.	14 pounds oat hay.
Daily cost 19.8 cents.	Daily cost 17.8 cents.

Horse.	Rhody.	Tom.*	Date.	Roxy.	George.*
Weights	990	752	August 21	996	788
	1020	748	28	1032	799
	1014	766	September 3	1028	790
Average	1008	755		1018	792
Normal	1012	753		966	779
Work done	130	102		130	119

* Tom and George were fed ¾ quantity above ration.

The gain in weight continues for all. The wheat ration has an average gain over preceding period of 15 pounds for Rhody and 11 pounds for Tom, while the cowpea ration has a gain of 23 pounds for Roxy and 13 pounds for George. Cowpeas, as a rule, are cheaper than wheat, and in both of these trials were equal, if not superior, as a feeding stuff for mules.

On September 3 the rations were changed by decreasing the quantity of corn in both rations and increasing the quantity of wheat and cowpeas. The plan and results are as follows:

Ration 54.	Ration 55
8 pounds ground wheat.	8 pounds ground cowpeas.
4 pounds corn and cob meal.	4 pounds corn and cob meal.
14 pounds oat hay.	14 pounds oat hay.
Daily cost 19.4 cents.	Daily cost 15.4 cents.

Horse.	Rhody.	Date.	Roxy.
Weights	1014	September 3	1028
	1012	11	1007
	1000	18	1022
Average	1009		1019
Normal	1012		966
Work done	132		132

By studying this table and the preceding one it will be noticed that there is a gain of one pound for each mule in period average weight. The tables suggest that both rations are quite equal in value, and also that wheat and cowpeas are substitutes equal in value to corn. Wheat is ordinarily more expensive than corn, and therefore is of importance only when the market prices are similar. Cowpeas, on the other hand, improve the soil in their growing and can be economically produced, and at a cost per bushel even more cheaply than corn. Cowpeas and corn fed as concentrates make a safe, practical and efficient grain ration.

On September 18 the rations for Rhody and Roxy were changed again, and the following substituted:

Ration 56	Ration 57.
15 pounds green corn in ear.	20 pounds green corn in ear.
5 pounds ground wheat.	14 pounds oat hay.
14 pounds oat hay.	

Horse.	Rhody.	Date.	Roxy.
	1000	September 18	1022
	1000	25	1000
Weights	1030	October 1	1004
	1012	8	1018
Average	1012		1011
Normal	1012		966
Work done	198		198

In this case Rhody has an average gain over last period of 3 pounds, and Roxy an average period loss of 8 pounds. Here is a slight difference in favor of the wheat in the ration. The cost of the corn-wheat ration is slightly higher than the corn ration.

Oats Compared with Cowpeas.

On August 7 Daisy and Mary were fed different rations for the purpose of comparing oats and cowpeas. The plan and results follow in next table:

Ration 58.	Ration 59.
4 pounds ground oats.	4 pounds ground cowpeas.
4 pounds ground wheat.	4 pounds ground wheat.
4 pounds corn and cob meal.	4 pounds corn and cob meal.
14 pounds meadow hay.	14 pounds meadow hay.
Daily cost 24.4 cents.	Daily cost 20.4 cents.

Horse.	Daisy.	Date.		Mary.
Weights	1160	August	7	1066
	1220		14	1102
	1222		21	1086
Average	1201			1085
Normal	1210			1091
Work done	79			79

On August 21, 14 pounds of oat hay were substituted for the meadow hay.

Weights	1220	September	28	1110
	1216	October	3	1102
	1250		11	1030
	1222		18	1104
	1212		25	1112
Average	1223			1091
Normal	1210			1091
Work done	237			281

The data show that both gained in weight, and that both rations were satisfactory in every sense of the word. The cowpeas used in these tests were bought for 60 cents per bushel (an exceptionally low price for peas), and oats for 65 cents per bushel. The practical suggestion is, that since both proved effective and satisfactory, the

matter of cost must be considered. The oats cost a fraction over 2 cents per pound and the cowpeas 1 cent even. It is easy to see that cowpeas were the most economical and practical feed in this case.

Condition of Animals at Beginning and Ending.

During the time the horses and mules were being used in the experiments discussed in the preceding pages they were under the same conditions of shelter, water, grooming and care. The table below gives the weights of each animal at the beginning and ending for the time the respective animals were under experimentation:

Weights at Beginning and Ending.

	Daisy.	Doll.	Tom.	George.	Rhody.	Roxy.	Mary.	Sue.
Beginning—first weighing	1200	1285	767	777	973	935	1090	983
Ending—last weighing	1280	1310	766	790	1012	1018	1112	995
Gain	80	25	....	13	39	83	22	12
Loss	———	———	1	....	.....	.....	.....	....
Normal or average for whole period	1210	1308	753	779	1012	966	1091	984

When the period averages are taken, the results are as follows:

Period Weights for Beginning and Ending.

	Daisy.	Doll.	Tom.	George.	Rhody.	Roxy.	Mary.	Sue.
Beginning or first period	1148	1251	753	759	969	939	1079	973
Ending or last period	1248	1329	755	792	1012	1011	1091	981
Gain	100	78	2	33	43	72	12	8
Normal or average for whole period	1210	1308	753	779	966	966	1091	984

Summary.

1. The tests made, and as discussed in the preceding pages, show that the forage crops now grown in North Carolina are adapted to horse-feeding; they are efficient, easily grown and available for every farmer. The tests show it is not necessary to purchase feeding stuffs outside of the State.

2. Cowpea hay is a valuable horse feed. Combined with corn and cob meal it makes a practical working ration. It can also be substituted for bran and oats, providing a reasonable quantity of corn is added to the daily ration.

3. Corn ensilage is a superior feed for horses and mules. One of the most satisfactory rations fed in this series of experiments was composed of 21 pounds of ensilage, 15 pounds of corn, 2 pounds of bran and 1 pound of cotton seed meal. The ration was cheap, efficient and wholesome to the animals.

4. Corn stover is a roughage material that is exceeding valuable for feeding farm horses and mules. It is a good substitute for hay for the winter feeding of horses and mules because of its feeding value, the yield per acre and commercial value.

5. Oat hay when cut while in the milk state is a satisfactory horse feed. When thus harvested it compares favorably with clover hay and cowpea hay.

6. Cotton seed meal can be used to displace a part of the corn or oats in a horse or mule ration. Two pounds of cotton seed meal as a part of the daily rations were fed to horses and mules with satisfaction. This quantity can be fed in a mixture with either grain or sprinkled on ensilage or on hay or stover that has been moistened previously to feeding.

In comparison with other feeding stuffs cotton seed meal, because of its high feeding value, is a relatively cheap feed. Corn stover, corn and cotton seed meal, because of feeding and commercial values, make satisfactory rations for winter feeding of horses and mules, or at other times when on light or moderate work.

Some of the animals in these experiments did not at first relish cotton seed meal. Where animals can be made to acquire the taste, it should be made a part of the daily ration.

7. Tankage and dried blood were used in these tests satisfactorily. The latter is especially valuable when horses are "run down" and thin in flesh.

Further tests are necessary to demonstrate the extent of the feeding of dried blood and tankage to know their fullest efficiency.

8. Bran was used as a substitute for oats and for corn acceptably and successfully. When it can be obtained at a moderate cost it should always find a place in feeding work animals. When corn

and oats, though home-grown, are high commercially, it is often economy to sell part of the corn and oats in exchange for bran, providing the latter is not likewise temporarily high in market value.

9. When the whole ear is ground, making what is termed here corn and cob meal, the same efficiency in work and maintenance of weight in horses and mules follows as where an equal quantity of shelled corn is fed.

10. When corn on the ear was compared with an equal quantity of corn ground, the cob included in the latter, the difference was in the favor of the corn and cob meal, when corn stover was used as a roughage. When clover hay was used as a roughage the difference is not sufficient to note. Whether corn shall be ground or not will depend on the cost in labor and trouble in performing the operation.

11. When wheat and cowpeas were compared as a part of the grain ration, cowpeas were equal to wheat, or slightly better. The cost of production and commercial value must always be considered when either is to be fed in connection with or as a substitute for other concentrates.

12. Cowpeas are a satisfactory substitute for oats in feeding farm horses and mules.

13. Various kinds of feeding stuffs can be used to advantage and with economy in feeding farm horses and mules.

14. There is no so-called "one ration for horses."

15. A mixture of corn and bran, or of corn and cowpeas, or of corn, bran and cotton seed meal, is a good substitute for corn and oats in feeding work animals.

16. Any feeding stuff or combination of feeding stuffs that furnishes the necessary and desirable nutrients at least cost, should be the important consideration in the preparation of rations for farm horses and mules.